100 DNA: The Evidence Within

INVESTIGATION

Scientists use evidence such as similarities in skeletal structures and other physical traits to investigate evolutionary relationships. Thanks to advances in genetics and biotechnology, scientists studying evolution can now also use the genetic material itself.

These scientists are analyzing evidence from DNA.

Each cell in an organism contains the genetic information needed to perform all its functions, such as obtaining energy, moving, and getting rid of wastes. You may already know that the genetic information is located in DNA in the chromosomes found in every cell. DNA is made up of four chemicals whose names are abbreviated as A, T, G, and C. These chemicals are strung together like beads on a string. Differences in their order result in different messages. Think of these chemicals as letters in an alphabet: there are only 26 letters in the English alphabet, but there are millions of words. In a similar way, DNA contains millions of biological messages. The more similar the DNA, the more similar the messages used to run the organism.

CHALLENGE

How does DNA provide evidence about how animals are related?

MATERIALS

For each group of four students

- **1 Student Sheet 100.1, "DNA Samples"**
- **1 Student Sheet 100.2, "Unusual Vertebrates"**
- **1 Student Sheet 100.3, "Comparing Primates" (optional)**
- **1 pair of scissors**

The Common Thread

You are an evolutionary biologist investigating relationships among different species. When a geneticist you work with offers to provide you with DNA samples from various animals, you do some background research. You find out that the samples are from a gene that is similar in all vertebrates. This means you can easily use them to compare species of vertebrates.

PROCEDURE

Part A: Comparing Vertebrate Classes

1. The two-page chart at the end of this activity shows how to classify vertebrates. If you did not complete Activity 76, "People, Birds, and Bats," from the Ecology unit of *Issues and Life Science,* your teacher will give you a Student Sheet with examples of some unusual vertebrates to classify.
2. Compare the five samples of DNA on Student Sheet 100.1, "DNA Samples." With your partner, discuss any similarities or differences that you notice among the samples.
3. Use the DNA samples to determine whether animals in the same class have more similarities in their DNA with one another than they do with animals in other classes. Record your ideas in your science notebook.

   Hint: First compare just two animals and count the number of differences in their DNA. You can make a table like the one shown below to record these counts.

Numbers of Differences Between DNA Sequences

	Mammal #1	Mammal #2	Mammal #3	Reptile
Fish				
Mammal #1	—			
Mammal #2	—	—		
Mammal #3	—	—	—	

4. In Activity 99, "A Whale of a Tale," you examined evidence that whales are mammals. Look again at your DNA samples. Discuss with your group whether these samples provide additional evidence that whales are mammals.

Part B: Gathering More Evidence

5. In Activity 76, "People, Birds, and Bats," you classified a number of vertebrates into different classes. Review how you classified four of these animals: the kiwi, platypus, armadillo, and bat.

6. A local biotechnology center provides you and the geneticist with DNA samples from these four animals. Use Student Sheet 100.2, "Unusual Vertebrates," to compare the DNA samples of these four animals with the DNA samples from Part A. In your science notebook, create a table similar to the one above to record your comparisons.

7. In your science notebook, record whether the DNA evidence supports or conflicts with the way that you had classified these animals. If you make any changes to your classification, be sure to record them.

ANALYSIS

1. In this activity, you used DNA to evaluate relationships among animals. How does DNA provide evidence about how species are related?

2. Would you expect the DNA of a seahorse to be more like the DNA of a horse or the DNA of a trout? Use evidence from this activity to support your answer.

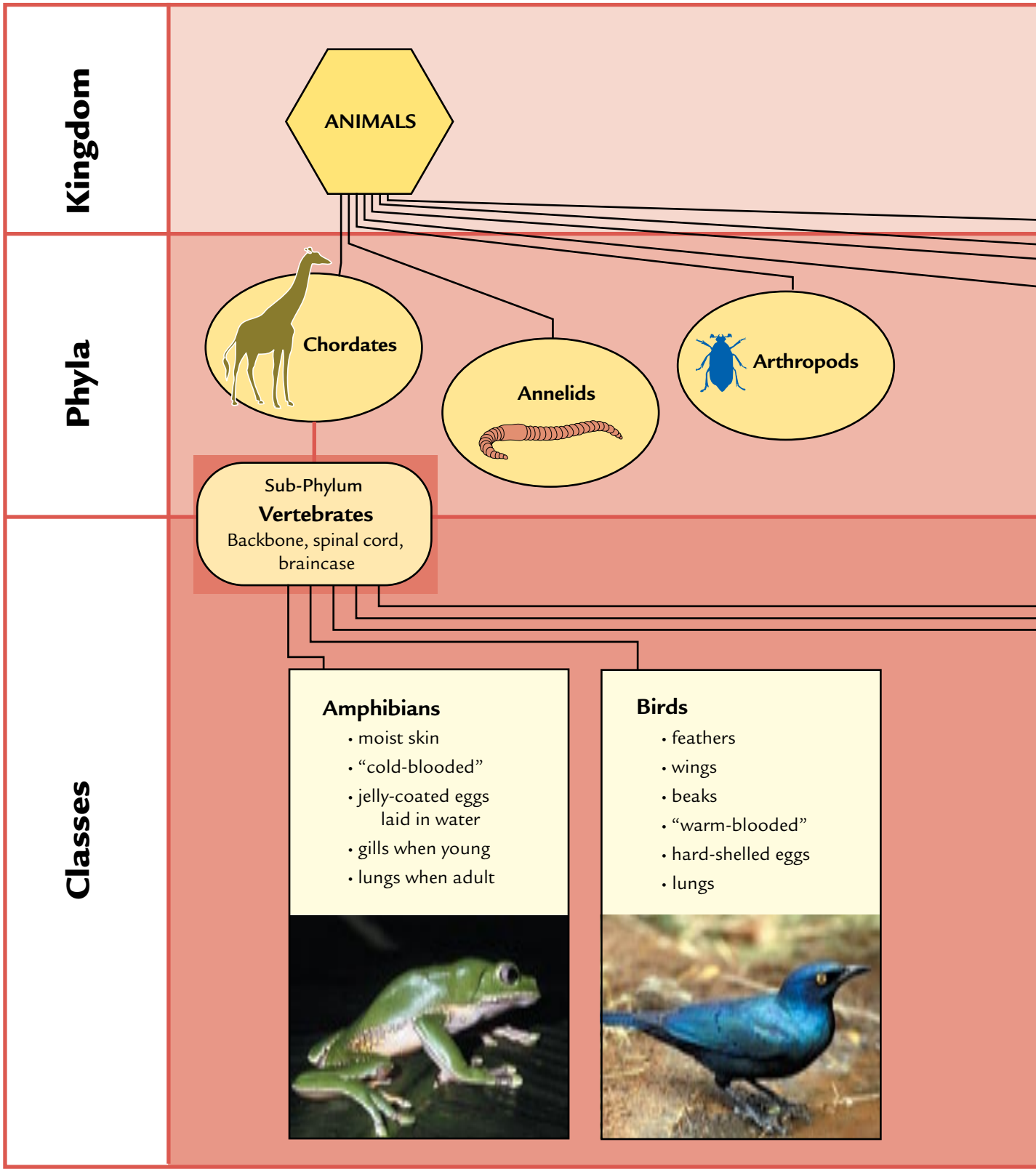
3. **a.** Look back at the evolutionary tree in Figure 2 of Activity 89, "Here Today, Gone Tomorrow?" Draw a simple tree that shows the evolution of reptiles, fish, and mammals.

   b. Explain how DNA evidence helps you draw evolutionary trees.

4. The first mammals evolved from a reptilian ancestor, 200 million years ago. Explain why it is not accurate to say that humans evolved from lizards.

EXTENSION

Compare the human, chimpanzee, and rhesus monkey DNA sequences provided on Student Sheet 100.3, "Comparing Primates." Use this evidence to draw an evolutionary tree for these three types of primates.


Kingdom
Phyla
Classes
ANIMALS
Chordates
Annelids
Arthropods
Sub-Phylum
Vertebrates
Backbone, spinal cord, braincase
Amphibians
• moist skin
• "cold-blooded"
• jelly-coated eggs laid in water
• gills when young
• lungs when adult
Birds
• feathers
• wings
• beaks
• "warm-blooded"
• hard-shelled eggs
• lungs

Cnidaria

Flatworms

Mollusks

Many more invertebrate phyla

Bony Fish

- scaly skin
- "cold-blooded"
- jelly-coated eggs laid in water
- fins
- gills

Mammals

- hair
- "warm-blooded"
- live young
- feed babies milk
- lungs

Reptiles

- dry scaly skin
- "cold-blooded"
- leathery-shelled eggs
- lungs